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ABSTRACT

Reviewed were several research studies using varying dosages of methylphenidate (Ritalin) in contrast with thioridazine and amphetamine under various behavioral conditions and situations with hyperactive, emotionally disturbed, and learning disabled children. Results from the studies with hyperactive children indicated that drug treatment was effective only for formal settings (classroom, laboratory, etc.). The emotionally disturbed Ss showed deviant behavior to be affected by drugs, and classroom on-task behaviors increased with the use of methylphenidate in comparison with the placebo and thioridazine treatments. With the learning disabled, methylphenidate increased the number of correct responses concomitant with an increase in responding. Conclusions were drawn to the effect that methylphenidate enhances learning. (Author/IM)

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EFFECTS OF THE PSYCHOACTIVE DRUG: METHYLPHENIDATE (RITALIN) ON CLASSROOM DISORDERS: HYPERACTIVITY, EMOTIONAL DISTURBANCE AND LEARNING DISORDERS.

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ABSTRACT

Various research studies using methylphenidate (Ritalin) in contrast with thioridazine and amphetamine in addition to behavior modification techniques were investigated. Behavioral conditions and situations involving the various special modalities of hyperactivity, emotional disturbance and the learning disorders showed designs for control and experimental procedures. The importance of dosage levels was experimentally researched.

One of these designs involved nine subjects who were given one of four dosages of methylphenidate. Conclusive data was obtained by determining how many times children who were in this dosage experiment played on various playground equipment. The procedure for the emotionally disturbed subjects (12 boys) employed dosage levels where the sequence of medication was counterbalanced and amounts varied. Investigations for the learning disabled children used a short term memory task in the form of matrix design which was presented and the subjects viewed the design. They were asked to remember the matrix for a few seconds then indicate on a test trial if the picture or specific stimulus was present.

Results from the research studies for the hyperactive child on the varied playground equipment (the informal condition) was only effective for formal settings: classroom, lab situations, etc. The emotionally disturbed experimental situations showed deviant behavior to be affected by drugs. Isolations showed a significant difference between the methylphenidate treatment and other medications with the methylphenidate condition

producing fewer isolations. The classroom on-task-behaviors showed an increase with the use of methylphenidate in comparison with the placebo and thioridazine treatments. Teacher initiated pupil-contact conditions showed methylphenidate to be statistically significant than either the placebo or thioridazine dosages. The effects of the learning disability condition showed that methylphenidate increased the number of correct responses concomitant with an increase in responding. Thioridazine reduced the number of correct responses as well as the speed on this same task. Conclusions were drawn to the effect that methylphenidate enhances learning.

Based on the results of these various studies, it is suggested that the length of time that the subjects are on medication be intermittently terminated every nine months. It is further suggested that the effects of these cessations of removal from drugs be statistically investigated.

A SUMMARY OF THE RESEARCH ON THE EFFECTS OF THE PSYCHOACTIVE DRUG, METHYLPHENIDATE, (RITALIN) ON CLASSROOM DISORDERS: HYPERACTIVITY, EMOTIONAL DISTURBANCE AND LEARNING DISORDERS.

A school day starts and Johnny who has been quiet for twenty minutes, begins to look around, spies a friend and few feet away and throws a pencil at this friend. This begins for Johnny a school day filled with warnings from the teacher and ending with the seemingly inevitable trip to the office.

After specific observation, a behavioral framework emerges which shows that Johnny has a short attention span, is highly susceptible to the power of suggestion and demonstrates a lack of control and discrimination in response to varied stimuli.

As this pattern of behavior continues, the teacher should begin to suspect a very serious need in this student and should refer the child to the school psychologist for identification of this student's needs. When it has been determined that the child is hyperactive with all the aspects of the condition understood by both teacher, parents and the principal, the child should be seen by a physician. After a diagnosis is made, a prescriptive program should be planned for Johnny.

The psychoactive drug that will be discussed is methylphenidate (Ritalin) because of its predominant use in schools. Other drug studies are described because of their comparative effects with methylphenidate on behavior. If a student is on medication and a query is made as to the specific name of the drug prescribed, methylphenidate is named ninety per cent of the time.

The slight organic imbalance that leads to the presence of symptoms by which a need for medication is recognized in the growing child is usually abated at puberty. The literature usually specifies 11 to 12 years of age as the time at which most forms of developmental hyperactivity spontaneously subside. Meanwhile, all psychological processes need to be examined and preventive measures exercised to insure that Johnny develops in such a way as to avoid the failure syndrome, negative attitudes and all other possible undesirable patterns of behavior resulting from Johnny's temporary hyperactive state.

The following research will provide informative data on the effect of methylphenidate (Ritalin) on the varied conditions of the hyperactive state, emotional disturbance and learning disorders. Differences between the effects of this psychoactive drug when it is used in formal settings as compared with informal settings will be discussed. In addition, the degrees of preventiveness that methylphenidate entails and the alternatives, e.g., prescribed behavior modification methods that could be substituted for the use of a prescriptive drug, will be discussed.

Effect of Methylphenidate (Ritalin) on Hyperactivity:

Ellis et al (1971) made the observation that although methylphenidate has been beneficial in improving children's classroom response to varied stimuli, it had only been tested in a formal setting. This particular setting involved attendance to a specific task such as is found in nearly all classroom situations.

What remained to be examined was the effect of methylphenidate in informal situations. One such study, Witt et al (1971) had examined children in a play situation in which methylphenidate was found to be of little influence. A multivariate procedure was used in two studies and the negative results in the first study, Witt et al (1971) due to a design failure, resulted in the hypothesis formulated to measure the effect of methylphenidate on the behavior of hyperactive children playing in an informal setting.

In another study, Sprague and Slater, (1973) chose nine subjects, aged 8-10 years, who were designated by a physician as distractible, antisocial and hyperactive. Each of these nine boys was given one of four dosages. The collected data included the number of times children were on the play equipment, number of visits to equipment, total distance moved, average velocity of movement, average length of visit and total energy units.

The results revealed that the dependent variables (time on playground equipment, etc.) were correlated and both a multivariate and a univariate analysis of variance showed no differential effects of varying dosages of methylphenidate. This outcome suggests that methylphenidate has little effect on the behavior of hyperactive children in informal settings.

In addition to this study, data collected on the observation of teachers in formal settings and parents' impressions of the same children at home, (informal settings), showed similar

results statistically with a contrast occurring in teacher reporting and parent reporting. This differential could be due to the decrease in the effect of the drug after three o'clock in the afternoon if the dosage was given in the morning. This confirms the ever prevalent concept that drug amelioration is only effective in formal settings affecting hyperactive behavior. Complaints in connection with hyperactives arise from situations that demand high levels of compliance and attendance to tasks. It has been recommended that future studies pay closer attention to describing the conditions or combination of conditions under which methylphenidate will influence activity levels.

Two tentative conclusions were derived from these studies: the first, in relation to side effects, found that there is probably no need to fear noxious developmental side effects created by the depression of an active involvement with the environment. The second suggested that methylphenidate does not directly affect the energy expenditures of the child but does alter attentional mechanisms so that hyperactive children can respond more effectively in formal settings.

Methylphenidate and Classroom Behavior in Disturbed Children:

In a study by Sprague et al, (1970), the effects of three factorial conditions were measured with the Ss being a group of 12 boys from three research classes for emotionally disturbed children, viz., drugs (methylphenidate and thioridazine); a placebo condition; dosages (high and low) and varied amounts of

stimuli (number). The subjects (Ss) served as their own control, where each S participated in six experimental sessions. The value of each S serving as his own control is that the possibility of differences arising between the drug conditions due to sampling error is reduced.

The matrix design in Figure I shows the results of six experimental sessions, i.e., two drug and a placebo condition at each of two dosage levels. These dosages ranged from 0.25 mg/kg. (low) to 0.35 mg/kg. (high) for methylphenidate; for thioridazine, 0.75 mg/kg. to 1.00 mg/kg. and tablets of similar size and number were given in the placebo condition. The amount of dosage had been established empirically in previous work. Within each dosage level, the sequence of the medication was completely counterbalanced, i.e., two Ss received in order, methylphenidate, thioridazine and the placebo; another two received methylphenidate first,

FIGURE I

Analysis of Dependent Variables Measuring Response Accuracy, Reaction Time and Activity Level (seat movement).

	Response Accuracy	Reaction Time	Activity Level	
Medication	9.08	29.14	5.95	methylphenidate thioridazine, placebo
Dosages	1.22	1.44	6.06	varied: low to high amounts
Stimuli	26.25	44.38	1.60	picture matrix one, two, three

the placebo condition, second and thioridazine, third, etc. Stimuli

were chosen in the basis of overall experiential value without dimensional emotional overtones. The training trial involved a stimuli matrix of one, two and three pictures where after an interval of four seconds, the test trial began with an onset signal of a half second buzzer. This type of stimulus-response test required visual perception (gesalt or whole as opposed to parts), input and output analysis and synthesis, visual memory and motor co-ordination resulting in the motor response. The preceding measures were primarily a reaction time design with the drug factor as the main variable being measured. Feedback in the form of a reward was presented in the primary component as M & M candy which the S received when he made a correct response. At the end of the session, the S could take all the candy he had earned. Activity level or the amount of wriggling in the chair during the experimental session was measured by a stabilimetric cushion. Data were recorded on a trial by trial basis.

This same experiment became an in-depth study as was demonstrated by an experiment proper involving 20 trials which were preceded by 15 adaptation trials each experimental day. Drugs were administered in a triple blind design, i.e., neither the person giving the drug, the experimenter testing the S nor the S knew what medication was being administered. Only one experimenter knew what drugs were being administered and he was not involved in the observation or testing of the Ss.

The behavior of the Ss was measured beginning one and a half hours after the drug had been administered. The Ss were observed in a classroom situation. The method employed was one of interobserver reliability (trained observer's records of Ss interactions). Each child was observed for 20 minutes for the occurence of varied types of deviant behaviors, attention to school work and teacher-pupil contacts. In addition, there was a teacher's evaluation on a five point scale of the quality of that specific day plus the number and duration of any punishment accorded. Assuming the S was at the affective level of awareness, punishment was usually isolation from the class. In the laboratory situation, as already stated in the experiment proper, there were three dependent measures: accuracy of responding or the number of correct responses, reaction time in hundredths of a second with the activity or seat movement measured by the stabilimetric cushion during the experimental session.

This same extensive experiment required a preliminary analysis because any significant effect of either sequence of drug administration or practice over a six day period would be difficult to interpret. The analysis of this sequence was computed on the aforementioned factors (response accuracy, reaction time, activity level) and no significant difference was found. In the experiment proper, the effects of the drugs on one dependent measure, response accuracy, showed significance. Two empirical tests were employed for further assessment, viz., the Newman-Keuls and the Hartley. The results indicate that

methylphenidate produced significantly higher accuracy scores than either the placebo or thioridazine condition. The methylphenidate Ss also showed a significantly faster reaction time than either of the other groups. In the dosage conditions, dosage level did not significantly alter performance. Under the Hartley test, the activity level under the placebo and thioridazine treatments was almost identical, while, under methylphenidate, the activity was reduced. Again, dosage had no significant effect on activity level.

The amount of stimuli (number) presented during the training and during the experimental phase showed a significant influence on the S's performance. As the number of stimuli increased, the accuracy decreased. This was also the case with the effect of the number of stimuli on reaction time. As the number of stimuli increased, predictably, the reaction time became slower. There was no significant effect of the number of stimuli on the activity level. These results emphasize that the number of stimuli in the classroom decreases accuracy performance even under drug conditions.

The effect of drugs on classroom behavior, particularly, deviant behavior, showed only isolation to be affected by the drugs. The number of isolations showed a significant difference between the methylphenidate treatment and the other medications with the methylphenidate dosage producing fewer isolations. The classroom on-task behaviors showed an increase with the use of

methylphenidate in comparison with the placebo and thioridazine treatments. On the teacher-initiated pupil contact and quality of day conditions, the effect of methylphenidate was statistically significant than either placebo or thioridazine effects.

Another important facet reported in this study was the emphasis on the constrast between laboratory and clinical studies. In pediatric psychopharmacology, difficulties are found in measuring drug effects and in delineating the mechanism of any of the drug effects observed. This study was able to minimize errors usually found in drug measurements by the use of double-blind procedures and by employing proper controls, viz., contrast and crossover groups known respectively as (between-S) and (within-S) designs; this aided in reducing the effect of observer bias. To further reduce the large amount of variance normally attributable to error in clinical cases, this study employed the use of a laboratory as already described rather than a clinical milieu. Much of the measuring process in the laboratory as was possible was automated. In Table I the positive outcomes outweigh the negative outcomes whereby awareness of these outcomes can be anticipated and allowances planned.

Figure 2 shows the drug effects on both laboratory and clinical measures in this study whereby methylphenidate showed an increase in learning performance while thioridazine decreased performance. The activity level was also decreased under methylphenidate, which is inversely proportionate to increased

attention thereby increasing learning performance.

Table I

Laboratory Procedures	Clinical Procedures
Sources of error due to experimental effect minimized. Inconstancy of procedures minimized. Fluctuating state of environment minimized. Automating laboratory procedures highly reliable thereby more potentially sensitive to drug effects. Laboratory measures can be more readily rarified to yield more basic psychological processes affected by drugs.	Relevance of laboratory measures to the real life behavior of the child is obscure, thereby limiting their usefulness. In the search for reliability, laboratory measures may become so rarified that they neglect important elements of behavior, e.g., social interaction.

Figure 2

Response performance under three conditions: methylphenidate, placebo and thioridazine.

Behavior Deviant	Decrease	Increase	Small Increase	Activity Level (seat)
Teacher Pupil	Increase	Small Increase	Decrease	Reaction Time
Task Attention	Increase	Small Increase	Decrease	Overall Drug Learning
	Methyl-phenidate	Placebo	Thiori-dazine	

In this particular study the application of the dosage showed no difference in affect but this could be due to the narrow range of dosages within the three treatments, methylphenidate, placebo and thioridazine. It has been suggested that if there was an increase in range; four dosage levels of methylphenidate were employed, for example, some effect might be demonstrated.

Although the beneficial effect of drugs to increase learning is evident, a possible negative effect may in time outweigh the use of these drugs in a learning situation. Failure has been found in the transfer of learning in animals to the no-drug condition from the drug-condition. A researcher, Breitmeyer, (1968) found evidence that suggested that although learning of a discrimination under methylphenidate was enhanced, data showed a decrease in learning performance when the Ss were tested after a two day time lapse. This was in contrast to learning under the placebo condition. This differential forgetting under drug conditions suggests an interference with the memory mechanism. Specific identity of the mechanism whereby forgetting would be detectable could solve many associative transfer of learning problems. Once again, this emphasizes the correlation of learning and drug-facilitated learning. It has been suggested that more research is needed in this area.

Effects of Drugs on Learning Disorders:

The following data were compiled by Sprague and Sleator,

(1973) on the effects of psychopharmacologic drugs on children attending school. The data pertinent to the research in this paper was selected in reference to the framework of minimum scientific standards. This area of learning disorders is usually school-related and the description determining this condition according to Sprague and Sleator is one of the school problems which is manifested in the form of deficiencies in academic performance and concomitant (behavioral) problems in the classroom: poor attention, impulsivity, poor social behavior and hyperactivity. As was emphasized in a previous paper of mine the concurence of the researchers with my point of view states that all too frequently drugs have been prescribed and used without enough information to properly warrant their use in the proper context. The drug is usually held to be a panacea for solving all problems. Usually, there is just enough success to keep this practice at this level.

The literature shows that the increase of use of psychotropic drugs began during the 1960's and today, 91% of the physicians who treat hyperactive children as well as emotional and learning disordered children, prescribe these drugs. Another survey, in and around the Chicago area, showed that two to four per cent of the children in school were treated with the psychoactive drugs for the designated average duration of nine months.

As a contrast, we will compare the drug dextroamphetamine in various studies as well as methylphenidate. The following

is listed data derived from studies ranging from the brain-damaged child to the hyperactive youth:

1. This study, Epstein et al (1968) attempted to correlate excretion levels using dextroamphetamine with behavioral effects. The Ss were five brain-damaged and five control children who were out-patients. The brain-damaged children showed statistically significant increases of the amphetamine in excretion: the pH (acidity) of urine was higher and there was more urine increase from the brain-damaged Ss as compared to the control Ss.

2. Another study, Knight and Hinton, (1969), used 40 Ss of minimal brain-damaged children where methylphenidate and placebo were the treatments measuring their effect on motor performance and on physical tests. An increase in motor performance was obtained concomitant with an increase in heart rate.

3. In a direct comparison study, Sprague, (1972) the effects studied in a laboratory test of learning indicated that dextroamphetamine is not as twice as potent as methylphenidate as commonly believed.

4. It has been suggested that minimal brain dysfunction can be diagnoxed in infants and that methylphenidate treatment start at that age.

5. In questions of safety, regarding height and weight suppression, Safer et al, (1972) the data show that there may be growth suppression with methylphenidate if the dose is large enough, namely, about 20 mg. a day or about 0.6 mg. per kg. and above. This applies to children receiving long term treatment. No

information or study has been performed on short term treatment in children.

6. A five year follow-up study regarding long term effects indicated that there was a reduction in the hyperactivity of the child but that distraction was still predominant in the behavioral pattern. Weiss et al, (1971).

7. Another study showed that controls in comparison with hyperactive children exhibited far less failure than the hyperactive Ss indicating that failure could be more damaging as a habit formation even with drug treatment unless early treatment is used as a preventive measure. This is contingent upon an early diagnosis.

8. Studies employing other drugs which are pertinent to this research is the use of imipramine (used for encurisis) and dextroamphetamine. They were statistically more significant than the placebo condition and statistically more significant than the few differences between the two drugs. There is evidence that impramine would be helpful in the treatment of school phobia.

There has been little investigation on the effect of psychotropic drugs on learning in children and the data collected from these studies will be reported within a behavioral framework.

Connors et al, (1964), have found that methylphenidate enhances learning as measured by paired-associate learning and Porteus maze performance at about 1.4 mg. per kg. and in contrast, dextroamphetamine at about 0.7 mg. per kg. There was an increase

in visual paired-associate learning, Porteus maze performance and a specific increase on the Continuous Performance Test. This test is an effective laboratory measure of sustained attention or vigilance to a rather monotonous, usually visual, stimulus.

In a summary of years of work in comparing hyperactive children and learning disordered children with normal controls, the main problem was one of sustained attention in hyperactive children. Stimulants of the cerebral type (methylphenidate and dextroamphetamine) improved this condition. This supporting evidence already supports the accumulated data as outlined in this paper.

Some studies integrate both experimental learning and classroom data. In one such study, a short-term memory task in the form of a matrix design was presented and the S had to view the design, remember the matrix for a few seconds; then indicate on a test trial if the picture or presented stimulus was present. Results showed that methylphenidate in comparison with placebo significantly increased the number of correct responses concomitant with increasing the speed of responding. Thioridazine reduced the number of correct responses as well as the speed on the same task. Methylphenidate, in comparison with a standardized scale increased the child's attention to the task and also the appropriate social behavior which also showed a significant increase in comparison to the placebo treatment.

The dosage treatment showed that placebo significantly

increased the number of correct responses in comparison with no drug, and 0.2 and 0.3 mg. per kg. of methylphenidate increased correct responding in comparison with placebo, but further increases in the dosages up to 0.4 mg per kg., actually reduced correct responses.

Dissociation or state-dependent learning were terms applied to a reduction or failure to transfer a habit under a drug state to a non-drug state or vice versa. Dissociative learning has been investigated in one or two studies and in the study by Sprague, (1972) the evidence showed that learning under the drug habit was dissociated with the no-drug state. In the second study, Aman (1972) tested a group of hyperactive learning disordered children under methylphenidate using three different laboratory tasks: short-term memory, paired-associative learning and a motor performance task. The results showed no evidence to support state-dependent learning. These non-conclusive results suggest the need for further research.

As stated previously, very little investigation was made in the classroom condition because lack of adequate measuring techniques made mensuration difficult. In Figure 3 a teacher rating scale was developed by Connors, (1969) which factorized four items containing ten observations to measure clinically in the classroom the effects of drugs on the child's behavior. Application of this scale, as seen in Figure 3 (one to four weeks of observations were checked on a four range basis, averaged and mean scored) tested a sample of 25 hyperactive Ss in the

methylphenidate condition. The problems of clinical testing in observation rating and the dosage condition was again inadequate with the same comparable interpretations. This was verified by the discrepancies in the teacher rating instruments and the laboratory tests of learning. Another problem was the coordination of the psychopharmacological treatment of the child with special learning conditions such as special education programs, prescriptive tutoring and behavior modification programs. Again, there is little or no information of the interactive effects of the drug treatment and these learning procedures.

Figure 3

Connor's Abbreviated Teacher Rating Scale

Observation	Degree of Activity			
	Not at all 0	Just a little 1	Pretty Much 2	Very Much 3
1. Restless or overactive				
2. Excitable, impulsive				
3. Disturbs other children				
4. Fails to finish things he starts, short attention span				
5. Constantly fidgeting				
6. Inattentive, easily distracted				
7. Demands must be met immediately, easily frustrated				
8. Cries often and easily				
9. Mood changes quickly and drastically				
10. Temper outbursts, explosive and unpredictable behavior				

A study by Christensen (1973) in an experimental classroom with a methylphenidate and a placebo group, showed that seat movement in a stabilimetric condition (a cushion that measures seat movement) was significantly reduced with the use of methylphenidate. A behavior modification procedure was introduced and tested in the same condition, then, in turn, was tested in combination with placebo and methylphenidate and according to the results, methylphenidate led significantly whereas the behavior modification procedure by itself was not significant. The specific procedure in this study for the behavior modification condition was not stated, thereby leaving open to question the validity of this study. More investigation in this particular framework needs to be studied.

Play and the Effect of Methylphenidate:

This section is important as play or free time is offered usually as reward in the classroom. Laboratory studies of playroom behavior show that methylphenidate does not significantly affect behavior at the activity level. It could be that the measure is unreliable and the data supporting this is based on a study using dextroamphetamine as compared to methylphenidate treatment. The dextroamphetamine study investigated activity in a playroom. A floor grid measure was taken and showed a significant effect. In addition, another laboratory study was made using observational ratings and four second interval pictures. Unfortunately, such photographs cannot show certain behavioral

responses such as a movement continuum. The movements measured were gross movements such as moving toward playroom equipment and the length of activity at this equipment. Very little research has been done in this area and it has been suggested that more is definitely needed.

Results and Evaluations:

Psychotropic drugs increase attention mechanisms particularly in a structured situation. When the child is in a free-field situation, the effects are not as detectable. Another laboratory study in Montreal determined that the child showed less ability when paced in a task situation by another person in contrast to his own pacing in a similar situation. This supports the data that the effect of the drug, methylphenidate, is more significant in a structured situation than in one that is not. The duration of the effect of the drug was determined to be four to five hours and was usually administered in the morning, a main recommendation throughout this study. This morning dosage accounts for the observations by the parents being unreliable due to the very fact that the drug effects were usually worn off by the time the child returned home.

It is suggested that physicians and teachers and also parents use the Connor's Abbreviated Teacher Rating Scale (see Figure 3) every month that the child is on the drug to obtain a safe and accurate overall picture of the child's performance during these periods. The recommended dosage was to be kept at

standardized levels as opposed to titrated (varied) levels. It was found that the dosage of 0.3 mg. per kg. was the level at which there was some increment in learning during a short term memory task and in addition clinical ratings showed this significance from teacher as well as physician observational responses.

Side effects were shown to increase in the methylphenidate conditions proportionate to the measure of dosage as well as an increase in heart rate.

The general feeling one derives from these studies and also from this worker's observation of a student on the drug, methylphenidate, is the pervasiveness of uncertainty towards this particular area (drug behavioral treatment) both on the part of the physicians and the teachers involved. An attitude that drug treatment is a cure-all is the response one obtains when the focus is on this situation. More interest and more knowledge pertinent to this important area is needed. This is supported by the evidence of the unaccumulated data obtained on the hyperactive, the emotionally disturbed and learning disordered conditions.

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